

Did the Lupine Change the Pumice Plain? A Claim-Evidence-Reasoning Case

Learning target: I can construct a written argument, supported by evidence from repeated plot measurements, that the arrival of one population changed a physical component of an ecosystem and shifted other populations.

Claim, evidence, reasoning

About 45 min

Individual

MS-LS2-4 · assesses

MS-LS2-1 · supports

writing

data analysis

Name _____

Date _____

Period _____

Directions

Read the scenario and the facts box, then study the table. The table is a teaching dataset: the numbers were invented to match patterns ecologists have reported on the Pumice Plain, but they are not real measurements. Answer the warm-up questions first; they help you organize your evidence. Then write your argument in the claim, evidence and reasoning boxes, using years and numbers. Finish with the two questions after the argument.

You will need: This worksheet, Pencil, Calculator (optional)

The scenario

By the late 1980s, prairie lupine was spreading across parts of the Pumice Plain at Mount St. Helens, and other plants and small animals seemed to gather wherever it grew. That raises a cause-and-effect question. Did lupine change the plain in ways that helped other populations? Or did lupine simply grow in spots that were already wetter or richer, where other living things would have done well anyway? To find out, a research team marked twelve permanent plots, each 4 square meters, on bare pumice in 1986, before lupine had reached that part of the plain. In 1986 the team also measured soil moisture and found it the same in all twelve plots, about 9 percent water. Over the next four years lupine seeds arrived on their own in six of the plots (Group L). The other six never got lupine (Group B, for bare). Every four years the team measured the same things in the same way.

Facts about prairie lupine — Prairie lupine is a legume, a member of the pea family. Small bumps called nodules on its roots hold bacteria that take nitrogen gas from the air and change it into a form plants can use. Nearly all plants need usable nitrogen to grow, and fresh pumice has very little. When lupine leaves and stems die, they decay into the pumice and add nitrogen and other nutrients. Living lupines form low mats that trap windblown seeds and give insects food and shelter; spiders and beetles hunt those insects. Living lupines also use water and space that a seedling right beside them could have used.

Pumice Plain plots with and without lupine, 1986 to 1998 (teaching dataset)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Year	Group	Lupine cover (% of plot)	Usable soil nitrogen (mg/kg)	Seedlings of other plants (per plot)	Insects and spiders (per trap per week)
1986	L (lupine arrived later)	0	12	0.3	2
1986	B (no lupine)	0	11	0.5	2
1990	L	18	16	0.6	9
1990	B	0	12	0.7	3
1994	L	46	38	2.9	21
1994	B	0	13	1.0	4
1998	L	52	61	7.5	26
1998	B	0	15	1.8	5

Simulated data for teaching. Each value is the average of six plots. Usable soil nitrogen is in milligrams per kilogram of pumice. Seedlings are of species other than lupine. Insects and spiders were caught in one small cup trap per plot over one week.

Warm-up: organize the evidence

1. How much did usable soil nitrogen change from 1986 to 1998 in Group L, and in Group B? How many times larger was Group L's increase? Show your work.

2. Look only at the 1986 rows and the moisture measurement in the scenario. How similar were the two groups before lupine arrived, and why does the argument need this information?

3. In Group L, insects and spiders jumped between 1986 and 1990, but seedlings of other plants hardly changed until after 1990. Use numbers to show this, and suggest a reason for the different timing.

Your argument

CLAIM

Claim: Did the arrival of lupine change the Pumice Plain in a way that affected other populations? Write one sentence that names the physical change lupine caused and at least two populations that changed.

EVIDENCE

Evidence: Give at least three pieces of evidence from the table, each with years and numbers. At least one must compare Group L with Group B in the same year, and at least one must use the 1986 rows.

REASONING

Reasoning: Explain why your evidence supports your claim. Describe the mechanism: how lupine changes the soil, and why that matters to other plants and to insects and spiders. Explain how the 1986 rows and Group B rule out the idea that lupine just grew in better spots. End by naming one limit of this evidence.

After you write

4. Ecologists studying real lupines on the Pumice Plain found that seedlings of other plants often struggled right next to a living lupine, but did especially well in spots where a lupine had grown and then died. Does this finding weaken your claim, strengthen it, or change part of it? Explain.

5. Seedlings in Group B also rose a little, from 0.5 to 1.8 per plot. Give one possible reason, and explain with numbers why this does not undo your claim.

Sentence frames for each part

Claim: 'When lupine arrived, it changed the ___ of the pumice, and as a result ___ and ___ increased.'

Evidence: 'In 1986, Group L had ___ and Group B had ___. By 1998, Group L had ___ while Group B had ___.'

Reasoning: 'This shows ___ because lupine ___. Since the two groups were alike in 1986, the difference cannot be explained by ___. One limit is ___.' Circle the numbers in the table before you write so you can find them again quickly.

Design the experiment that would settle it

In this study, lupine chose the plots by arriving on its own, so the team could not be completely sure the six lupine plots were not special in some way they did not measure. Design an experiment that removes that doubt. Describe how you would decide which plots get lupine (for example, by planting seeds in plots chosen by coin flip), what you would do in comparison plots, and whether you would add a third group of plots where planted lupines are removed after a few years. Predict the results for each group, and explain how they would separate the effect of living lupines from the effect of dead ones.